SUNDARBANS HONEY AND THE MANGROVE SWAMPS[1]

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The present paper discusses various aspects of honey production and the behaviour pattern of the honey bees in the estuarine tracts of the Sundarbans where the terrain is peculiar, the environment is tropical and humid, wind velocity is high and the forests are dense and low. It covers the aspects of (i) annual honey and wax production and corresponding number of the permit holders and their casualties from man-eaters, (ii) the size pattern of the honey combs and corresponding honey production; (iii) honey production relating to the distance of honey comb from the ground level; (iv) host-comb relationship; (v) nectar, pollen grains and colour of honey; (vi) phenology of forest plants. The observations have been statistically analysed and the findings clearly stated and represented. These aspects of *Apis dorsata* have never been studied in such detail in estuarine tract in its natural habitat and the results of the observations has economic significance and will help at better work schedule for honey collection.

THE TRACT

The vast expanse of tidal swamp forests of the Sundarbans studded with fantastic labyrinths, bifurcations of rivers around tiny mud-flats are one of the thickest and impenetrable forests, where the honey bee (*Apis dorsata*) migrate during March to June every year. Numerous swarms of bees are ceaselessly active in collecting nectar from the vast tracts of forests flushed with fragrant flowers and forming huge low combs, close to the ground level. In a tract where venomous snakes, sharks, crocodiles, tigers and spotted deer occur. Honey collection in this animal infested terrain, where the forests are impenetrable, mud extremely soft, land inundated twice a day by high tide, innumerable sharp and hard pneumatophores point dangerously above ground level, is the most hazardous, laborious and risky among all type of work in the Sundarbans forests.

OBJECT OF STUDY

The study has been initiated to ascertain (i) the percentage of different plant species that form the host plant of the honey bees, (ii) if the bees are selective of any particular plant or plants for making combs and what is the percentage of different host plant species; (iii) if the comb size has any relation with the yield of honey and wax; (iv) if the height of comb from the ground level has any relation with yield of honey and wax; (v) if the pollen analysis of honey samples can indicate the nectar preference for any particular flower or flowers; (vi) the peak period of production; and (vii) the death pattern of the honey collectors and other permit holders from the tigers.

METHODS OF STUDY

A large number of honey combs were inspect-

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ed in different parts of forests over a wide area. The measurement of length, width and thickness were noted and honey and wax production for each comb was measured. These observations were also made by the field foresters and forest guards all over the forests (the tract is extensive and difficult) and recorded in proforma sheets specially made for this purpose. A number of honey collectors were also questioned and their observations were recorded. All these observations were later summarised. Samples of honey were microscopically examined and the host plants were identified from the pollen grains. Total collections from time to time were enumerated and correlated with flower production; fortnightly collections of honey were measured and continued for a period of 75 days.

Host plants

The bees showed the following perference percentages to trees for making honey combs

Avicennia sp.	—	16.0%
Heritiera formes	—	9.0%
Xylocarpus ganitrus	—	2.8%
X. gangeticus	—	1.9%
Rhizophora mucronata	—	10.0%
Cereops sp.	—	11.0%
Agialitis rotundifolia	—	1.0%
Excoecaria agallocha	—	39.0%
Aegiceros corniculatus	—	0.5%
Sonneratia apetala	—	5.3%
Bruguiera gymnorrhiza	—	3.5%

Excoecaria trees are an obvious choice. although this tree does not either have a suitable crown or spreading branches. *Phoenix-Excoecaria* combination offers an ideal habitat for the honey comb formation. The cool atmosphere and moisture laden tunnel formed by *Phoenix* palm with the *Excoecaria* branches hanging over the thickets have the maximum number of combs per unit area. Contrary to this, *Sonneratia apetala,* the tallest and much branched tree of the Sundarban forests does not have sufficient number of combs. *Xylocarpus* species are avoided although the trees have thick dense crown and are branched; yet *Heritiera* with its sporadic occurrence and light thin crown have a good percentage of combs in them. *Cereops* species which occupy 90% of the forest areas have only 11% of the combs; the reasons may be the shrubby bushes of C. *roxburghiana* and unbranched thick crown of *C. candolleana* both of which are found unsuitable for comb formation. The *Rhizophora* and *Avicennia* (*A. alba* and *A. officinalis*) have proportionately high percentage of combs although the trees grow only along the island boundary and beside the creeks, *khals* and rivers. The honey bees avoid such trees growing open or along a wide *khal* which is evident from complete absence of the combs on the trees standing along the boundary of islands that generally form the inspection route of the forest staff. Contrary to this, these species when they occur along narrow creeks inside the islands have a good number of combs.

Comb sizes and the yield of honey and wax

A number of honey combs occurring all over the forests were measured. It has been found that width and thickness are rather constant in all cases but the length is variable. The average calculated from the measurements is given below:

	Length	Width	Thickness
Maximum	120 cm	95 cm	7.5 cm
Average	75–90 cm	37–45 cm	6.0 cm
Minimum	37–45 cm	25 cm	6.0 cm

Honey yield corresponding to all available sizes was noted and the results of yield with size and distance from the ground level were analysed statistically. From actual measure-

ment it has been found that combs of 0.028 cubic meter volume yield about 3 kg of honey, combs of 0.035 cu. m. yield about 4-6 kg., combs of 0.042 cu. m. yield about 10 kg, and 0.056 cu. m. about 14 kg of honey, but the last two sizes are not of general occurrence.

But the honey output possibly depends on various factors like (i) proper strain of honey bee; (ii) ideal weather condition; (iii) size of comb; (iv) first or second formation; (v) distance from ground level; (iv) optimum flowering of tree species, and other factors.

A swarm of bees generally form only one honey comb on a tree however branched and wide-crowned the trees may be. It is only in 5 to 10% cases that two honey combs are formed on a tree. In such cases one becomes bigger and the other smaller. These perhaps are formed when there are two queen bees in a swarm. Not a single tree was found with three combs. Generally all the combs are constructed on a new site although the waxy bases of honey combs are left out on the branches to invite the honey bees to form combs for a second time. It is only in 7.3% cases that a second comb has been found constructed on the left-out waxy base of the first hive. The combs on slanting branches have been found to yield more honey than those on horizontal branches. Honey accumulates on the lower portions of the comb.

It has been found that the combs made early in the season are bigger in size. The combs that face at right angles to the rays of the sun have high honey contents.

Comb distance from the ground level and honey yield

Honey combs are formed at a very low height contrary to the comb-formation by this very species elsewhere. The trees in these forests are 5 to 10 metres tall, yet few combs are made above 4-5 metres from the ground level. Optimum height is 1.5 to 2.0 metres from the ground level. A survey of 406 trees showed that only ten trees contained combs above 2.5 metres from the ground level; the rest were at heights from 1.5 to 2.5 metres.

An effort has been made to find out a definite relationship between honey yield with length of honey comb and distance from the ground level. It shows that honey yield has a definite relation with the size. Normally, with the increase in the distance of the comb from the ground level there is an increase in the yield of honey up to the height of 2.59 metres. Any increase in height beyond that meant decrease in the yield of honey.

Another clear observation made was that during the last phase of honey comb-formation, low level branches were avoided and higher branches selected. It is because the forest environment close to ground gets hot at the lower levels. For the comb-formation for the second time *Avicennia, Sonneratia, Bruguiera* and *Rhizophora* species are selected. Honey combs formed in the *Excoecaria-Phoenix* formation were found at a height as low as 60 to 240 cm from ground level. (In *Phoenix* area the high tide water does not reach the tree level. Crabs have been found to eat honey in these combs.)

The honey combs that are made for the second time have four characteristics:

(i) They are made far above ground level.
(ii) They are smaller in size, but
(iii) They yield comparatively more honey.
(iv) The quantity of wax is proportionately more than the first formation.

Honey combs which are formed at the fag end of the season from *Excoecaria agallocha* nectar are smaller in size, but the honey content is comparatively more. Statistical analysis of random sample of 60 combs suggests that in 98% cases the distance of honey comb

from the ground level lies within 1.5 to 2.1 metres. But the optimum distance of honey comb which yields the maximum quantity of honey has been found to be 2.5 metres other factors remaining constant.

Phenology and honey production

The phenological pattern shows the peak period of flowering of different species of flowering plants. This can be divided into several 15-day phase as follows

Phase I
- March 20th to April 5th
  - *Aegiceros corniculatus*
  - *Acanthus illicifolius*
  - *Suaeda maritima* and
  - *Sisuvium portulacastrum*
- March 31st to April 15th
  - *Phoenix paludosa*
- April 5th to April 20th
  - *Cereops* sp.

Honey formed from the first four flowers has thick consistency and is creamy white in colour. Honey made from *Aigeceros* nectar is considered best and is cream coloured. Honey from *Cereops* is a bit reddish.

Phase II April 15th to May 5th

Sonneratia apetala

Honey derived out of these flowers is yellowish and slightly light.

Phase III May 1st to May 20th

Avicennia sp.

The honey has reddish tinge and is light.

Phase IV May 20th to June 5th

Excoecaria agallocha

The honey has reddish colour and its taste is slightly acidic and hot. It has fermented effect and burns the throat. The bulk collection of honey occurs in the following sequence from April to June. The results are shown as follows:

April 1st to April 15th	—	40.8%
April 16th to April 30th	—	33.2%
May 1st to May 15th	—	20.0%
May 16th to May 31st	—	4.4%
June 1st to June 15th	—	1.6%

This gives an impression that the bulk of the honey is produced from *Aegiceros corniculatus, Xylocarpus* species, *Acanthus illicifolius* (a shrub), *Phoenix paludosa* and *Cereops.*

Similarly the honey that is collected during the latter half of April is mainly from *Sonneratia* and *Cereops.* The last phase of collection is from a mixture of many species of which *Excoecaria agallocha* contributes maximum (verified from the pollen study).

But analysis of a few samples of honey under the microscope also shows the pollen grains of several species that do not even occur in the reserved forests area or in the vicinity. Such analysis shows good quantity of *Cereops* pollen and the pollen of *Crotalaria* and several other species that do not occur in the Sundarban forests.

Nectar, Pollen production and weather

Nectar is a product of glandular secretion. All the flowering trees of the Sundarbans have small and fragrant flowers (*Acanthus illicifolius* and *Derris* species have bigger flowers). Nectar and pollen grains are food of the bees. The coloration in honey, is held by some experts to be, due to climatic conditions and also owing to the chemical composition of the nectar. The pollen grains of the following species have been found mixed with honey:

Acanthus illicifolius — Yellow pollen grain
Rhizophora mucronata — Cream coloured grain
Bruguiera gymnorrhiza — Vermillion coloured grain
Xylocarpus sp. — Yellow to deep brown grain
Cereops sp. — Cream coloured grain
Phoenix paludosa — Red coloured grain

They do impart some colour to the honey.

Why does the honey bee, *Apis dorsata,* migrate to the Sundarban forests during March to July? Do the vast low forests with profuse, nectar yielding, fragrant flowers attract them? In migrating to these forests they have to cover hundreds of miles and work in an atmosphere where humidity varies from 75% to 85%. They work during the period in tropical humid climate, yet the bees detest continuous rain on bright sunny days, the former being detrimental to flush of flower and nectar formation, and the latter for changing the optimum humidity and temperature level. Sunny days with intermittent rains are ideal for honey production. Excessive rain or lack of rain affects normal honey production. Storms in the flower flushing season damage the flowers. The best nectar, it is said, is produced under the influence of suitable soil and in favourable climate; the Sundarbans perhaps provide such a soil and climate.

Honey bee and Wildlife

The honey bee operates in an area where the entire land mass is flooded in high tide and the land animals have to lead an amphibious life. Most important land animals are tigers, spotted deer, pigs and monkeys (*Macaca mulatta*). It has been observed that the monkeys and tigers are interested in honey and they do break the low-lying combs. The monkeys are said to smear the body with a thick layer of silt before approaching the combs! Crabs (*Scylla, Portunus,* and *Mutala* spp.), have been found clinging to the combs. Even though some aquatic mammals like the little porpoise, lizards (*Varanus* sp.), brackish water snakes (*Natrix, Enhydris, Gerardia* spp.), terrestrial snakes (*Naja, Dryophis, Python* spp.) and *Crocodylus porosus* live near the low-lying combs, yet the honey bees, it seems, are unconcerned. It is not known why the combs are made within easy reach of animals. Gastropods (*Nerita, Telescopium, Melongena, Lymnaea, Orchidium* spp.) may be associated with the comb in some way or the other.

But the profession of honey collection is associated with a tragic human problem. On an average over the last twenty years it is recorded that about 1000 honey collectors are engaged each year in this profession, amongst whom 10 fall victim to man-eaters, another 30 are attacked and robbed by dacoits. The annual average of honey collection was 450 quintals and wax about 40 quintals for the last twenty years.

Conclusion

The present study is a preliminary investigation. It has enabled us to find out the principal plant species responsible for best honey production, the best size and height of the combs from the ground level that yield maximum honey, and many other relevant information not so far recorded from this area. The findings have economic significance and it should be possible to manage the forests and formulate better work schedule for honey collection.